

1 (August 3, 2015)

2 **Rock Bolt and Rock Dowel Construction Requirements**

3 **Rock Bolt and Rock Dowel Installation Experience Requirements**

4 The Contractor's foreman supervising the rock bolt and rock dowel work shall have  
5 installed a minimum of 3,000 linear feet of post-tensioned rock bolts or rock dowels  
6 on a minimum of five projects within the past five years.

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8 The Contractor's rock bolt and rock dowel drill operators shall have installed a  
9 minimum of 1,000 linear feet of post-tensioned rock bolts or rock dowels on a  
10 minimum of three projects within the past five years.

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12 The Contractor shall submit a Type 2 Working Drawing consisting of a list  
13 documenting the rock bolt and rock dowel work experience of the foreman and drill  
14 operators working on the project. This list shall include a brief description of each  
15 project and a reference shall be included for each project listed. As a minimum, the  
16 reference shall include an individual's name and current phone number.

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18 Contractors or Subcontractors that are specifically prequalified in Class 39 Work  
19 will be considered to have met the above experience requirements.

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21 **Rock Bolt and Rock Dowel Submittals**

22 The Contractor shall submit Type 2 Working Drawings consisting of a rock bolt and  
23 rock dowel plan. The rock bolt and rock dowel plan shall include the following:

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- 25 1. The proposed construction sequence and schedule.
  - 26 2. The proposed drilling method and equipment.
  - 27 3. The proposed drill hole diameter.
  - 28 4. The minimum bond zone length for the rock bolts.
  - 29 5. The proposed anchor steel bars, couplers, nut, bearing plate, flat washer,  
30 and beveled washer specifications, including manufacturer's data sheets  
31 and mill certificates. Manufacturer's verification for the bearing plate  
32 thickness for the specified rock bolt and rock dowel capacities.
  - 33 6. The proposed grout mix design, including manufacturer's certificate of  
34 compliance and the procedures for placing the grout. For rock bolts, if  
35 two-stage grouting is used, the means for determining the level of the  
36 primary grout for the bond zone. If single-stage grouting is used, the  
37 fabrication details for the bondbreaker in the free-stressing length,  
38 including corrosion inhibiting compounds.
  - 39 7. The proposed corrosion protection for the rock bolt and rock dowel  
40 systems.
  - 41 8. The proposed stressing procedures and stressing equipment.
  - 42 9. The proposed construction method for upwardly inclined anchors.
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- 1 10. The proposed equipment for measuring and recording the volume of grout  
2 injected for production rock bolts and rock dowels.  
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4 11. The calibration data for each load cell, test jack, pressure gauge and  
5 master pressure gauge to be used in the proof testing, in accordance with  
6 the calibration requirements specified in Section 6-17.3(3).  
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#### 8 **Rock Bolt and Rock Dowel Preconstruction Conference**

9 A rock bolt and rock dowel preconstruction conference may be held at the  
10 discretion of the Engineer in accordance with Section 6-17.3(4).  
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#### 12 **Rock Bolt and Rock Dowel Storage and Handling**

13 Rock bolt and rock dowel storage and handling shall conform to the Section 6-  
14 17.3(6) requirements for permanent ground anchor tendons.  
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16 Field handling procedures for epoxy-coated rock bolts and rock dowels shall  
17 conform to Sections 6-02.3(24)H, including providing padding between contact  
18 points during storage and lifting, and covering epoxy-coated rock bolts and rock  
19 dowels to minimize ultraviolet exposure.  
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#### 21 **Rock Bolt and Rock Dowel Grout**

22 Grout shall meet the requirements of Section 9-20.3(2).  
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24 The use of epoxy or polyester resin as bonding agents will not be allowed.  
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#### 26 **Rock Bolt and Rock Dowel Installation**

##### 27 **General Requirements**

28 The Contractor shall install rock bolts and rock dowels at the location and  
29 orientation in accordance with the rock bolt and rock dowel plan accepted by  
30 the Engineer. For rock bolts, the Engineer will designate the required free-  
31 stressing length. For rock dowels, the Engineer will designate the minimum  
32 length.  
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34 The rock bolts and rock dowels shall be installed within five degrees of the  
35 orientation angle specified by the Engineer. Unless otherwise specified by the  
36 Engineer, the angle of installation shall be perpendicular to the rock face and  
37 inclined slightly downward at the rock bolt and rock dowel location.  
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39 In all cases, at least three-quarters of the bearing plate shall be in contact with  
40 the rock face. The orientation of the bearing plate against the rock surface  
41 should be within twenty degrees of normal to the bar. Beveled washers shall  
42 be used to accommodate all non-perpendicular installations, but should not  
43 exceed twenty degrees. If the axis of the anchor is not within five degrees of  
44 perpendicular to the rock surface, or within the angle provided by the beveled  
45 washer up to a maximum of twenty degrees, or if the rock beneath the bearing  
46 plate is not sound or is highly irregular as determined by the Engineer, a  
47 bearing pad accepted by the Engineer shall be constructed so that the bar is  
48 not bent when the nut is torqued during lock-off of the anchor. The Engineer  
49 may also require the use of over-sized bearing plates, when the rock surface is  
50 weak or highly weathered.  
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The use of hand drills for advancing the hole will not be allowed without the written permission of the Engineer and demonstrated effectiveness by the Contractor. The drill hole shall be sized to provide a minimum of 1/2 inches of grout cover around the rock bolt or rock dowel. The Contractor shall flush the drill hole of all drill cuttings and debris with compressed air prior to installing the rock bolt or rock dowel. Holes determined by the Engineer to be unacceptable for rock bolt and rock dowel installation shall be re-drilled by the Contractor at no additional expense to the Contracting Agency.

Rock bolts and rock dowels shall not be precut at the factory to lengths shown in the Plans, but rather shall be delivered to the job site in bulk lengths and field cut to the appropriate lengths. Each rock bolt and rock dowel shall be fitted with a bearing plate, nut, and washers. Prior to placing rock bolts and rock dowels in the drilled holes, all mill scale, flaking rust and grease shall be removed from the rock bolt and rock dowel.

Centralizers shall be placed along the rock bolt or rock dowel at ten foot centers prior to grouting, with a minimum of one centralizer per rock bolt or rock dowel. The lowermost centralizer shall be located within 12 inches of the end of the rock bolt or rock dowel. Centralizers shall be of sufficient strength to support the weight of the anchor bar in the drilled hole and provide a minimum of 0.5 inches of grout cover.

The grout equipment shall produce a grout free of lumps and undispersed cement. The pump shall be equipped with a pressure gauge near the discharge end to monitor grout pressures. The grouting equipment shall be sized to enable the grout to be pumped in one continuous operation. The grout shall be injected from the lowest point of the drill hole. Sufficient grout shall be placed in the drill hole to ensure full encapsulation of the rock bolt or rock dowel. The volume of grout injected, and the corresponding grout injection pressure, for each production rock bolt and rock dowel shall be measured using the methods and equipment specified in the rock bolt and rock dowel plan.

The entire length of the rock bolt and rock dowel shall be corrosion-protected with grout. Bare steel from field cutting of the anchor bar and any damaged galvanizing on the bearing plates, nuts and washers shall be painted in accordance with Section 6-07.3(10)P with one coat of galvanizing repair paint conforming to Section 9-08.1(2)B.

#### **Specific Rock Dowel Requirements**

The Contractor shall install Type 1 rock dowels to achieve the design load specified in the Plans; if the design load is not specified in the Plans a 25 kip design load should be used. When the grout has reached final set, the Contractor shall install the bearing plate, washers and nut. The nut shall be torqued to a nominal 100 foot-pounds to ensure proper seating against the rock face. The end of the completed rock dowel shall be trimmed to within six inches of the rock face.

#### **Specific Rock Bolt Requirements**

The Contractor shall select the type of rock bolt and construction method to be used. The Contractor shall embed and install rock bolts to achieve the design

1 load specified in the Plans. The rock bolt shall be sized so that the design load  
2 does not exceed 60 percent of the minimum ultimate tensile strength (MUTS)  
3 of the rock bolt. In addition, the rock bolt shall be sized so that the maximum  
4 test load does not exceed 80 percent of the MUTS for Grade 150 bar or 90  
5 percent of the minimum yield strength for Grade 75 bar. The end of the  
6 completed rock bolt shall be trimmed to within six inches of the rock face, and  
7 fitted with a galvanized steel anchorage cover filled with a corrosion-inhibiting  
8 compound.